STONE IN THE KIDNEY*

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DISCUSSION *by F. S. Dillingham, M. D., Los Angeles; Dozier H. Gibbs, M. D., Los Angeles; Miley B. Wesson, M. D., San Francisco.*

CALCULUS formation in the human kidney has been described by medical writers since the time of Hippocrates. Due to their inaccessibility, the technical difficulties involved and the uncertainty of the diagnosis, ancient surgeons rarely attempted the surgical removal of renal calculi, although they operated frequently for stone in the bladder. The symptoms of the disease, however, were well described by many early writers. Treatment consisted in efforts to control the pain of renal colic and measures intended to hasten the passage of stones. Some of these were fantastic and, needless to say, ineffectual. The earliest attempts at operative interference for stone consisted in the incision of palpable, lumbar swellings and the evacuation of pus in which calculi were occasionally found. Morris did the first nephrectomy for stone in 1880, and in the following year, 1881, Beck removed a kidney stone through an incision in the pelvis, the first pyelolithotomy. In 1896, which is within the memory of many of us here today, MacIntyre made the first positive x-ray diagnosis of a kidney stone. Prior to that epochal advance, exploratory exposures, that were of necessity often bilateral and fraught with disappointments, were the rule. Today the combined use of the cystoscope, the x-ray and, more recently, intravenous pyelography have so clarified the diagnosis of kidney pathology, including stone in the kidney, that an exploratory exposure of that organ is rarely, if ever, justified. The exact information to be derived from modern diagnostic methods has opened a new and fascinating field of conservative renal surgery. Many kidneys that formerly would have been removed can now be saved.

URINARY LITHIASIS

A discussion of stone in the kidney should include, in a large degree, the whole subject of urinary lithiasis; for nearly all stones found in the ureter and a large percentage of those seen in the bladder and urethra originated in the kidney and left that organ while still small enough to pass through the pelvic outlet. We believe it is quite possible that all stones found in the urinary tract, except certain prostatic concretions which are not true urinary calculi, and those stones with a foreign body as a nucleus, have actually originated in the kidney. In this connection a distinction should be made between the formation of a stone and its subsequent growth. For example, many bladder stones, on cross section, will show a nucleus of calcium oxalate or, more rarely, uric acid, surrounded by concentric layers of calcium or ammoniomagnesium salts, suggesting the renal origin of the nucleus and the vesical growth of the stone. Because of the frequent association of bladder stones with chronic urinary retention, such as occurs with hypertrophy of the prostate and contracted vesical neck, it has been believed that they begin and develop in the bladder, as a result of the stagnation of the retained urine. It is much more probable that the process of crystalline fusion actually begins in the tubules of the kidney, as a consequence of the secretory and chemical changes incident to chronic urinary obstruction, which produce a disturbance in the colloidal balance sufficient to precipitate and unite crystals. The frequent occurrence of renal stones in patients with prostatic obstruction adds weight to this theory. It is reasonable to assume that for every stone retained in these kidneys many microscopical crystalline fusions have passed down the ureter and reached the bladder as potential nuclei for vesical calculi.

There is ample clinical and experimental evidence to support the statement that urinary obstruction, with retention, is not of itself a cause of stone formation. If such were the case, we could expect calculous formation in the majority, if not all of the cases of hydronephrosis, when in reality it is infrequent. The larger the hydronephrosis, the less likely it will be for a stone to form, probably because of the diminished concentration of the urine that results from impaired function. Obstruction does hasten the growth of stone, however, especially in the presence of infection and alkalinuria.

FORMATION OF STONES

The majority of stones are formed in the kidney, and are composed of crystalloids of various urinary salts, held together by a colloidal matrix. In many stones these two substances are found in alternate layers, causing the laminations seen on section. The colloids are the binding material that holds the crystalloids together. When the colloidal matrix is dissolved experimentally outside the body, the crystalloid portion does not adhere, but crumbles into a fine powder. If stones formed purely as the result of a high concentration of salts that are normally in solution in the urine, as was formerly believed, it would probably be possible to prevent them by managing the diet and increasing the fluid intake. There is some additional quality in the urine of the most of us which enables it to retain many times more of the stone-forming salts in solution than could be dissolved in an equal quantity of water. Even this does not answer the question entirely, for many individuals constantly show crystals, in numbers sufficient to make the urine turbid, and never form stones. An exception should be made in cystinuria, which is a congenital, familial diathesis, due to a derangement of the intermediate metabolism of the body. In this rather rare condition, large numbers of cystine crystals are present in the urine and about 3 per cent will form cystine stones.

The solubility of the stone-forming substance apparently depends on the colloids. The diluent

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in urine is water. It has been estimated that it would require five gallons of water to dissolve the amount of uric acid eliminated in solution in a normal individual's urine each day. Just how the colloids can hold this excess of poorly soluble salts in suspension, and what factors stimulate or retard the colloidal mechanism, is a problem yet to be solved. A diminution in the protective colloidal mechanism below a certain point will cause an individual to form a stone in the absence of infection, urinary stasis, or a nucleus. At the present time there is some evidence that indicates that the colloidal mechanism, or what we have termed the "normal protection against stone," not only varies in different individuals, but may possibly increase or diminish in the same subject, depending on the hydrogen ion concentration, or p^H of the urine.

INFECTION

The rôle of infection in the formation of stones is still a mooted question. The work of Rosenow and Meisser, Hager and Magath, and others, has done much to prove the bacterial origin of certain stones, but it fails to explain the formation of calculi in a sterile urinary tract, of which there are many examples. Bacteria have been found in the centers of calculi as far back as 1886 (Galippe), and soft masses composed of bacteria and sufficiently dense to cast a shadow on an x-ray film, have been found in the kidney pelvis; but many renal calculi have been studied and cultured by careful observers with negative results.

DIETARY DEFICIENCY

The work of Osborne and Mendel, Fujimaki, Van Leersum, and others, would indicate that certain stones are the result of a deficiency of the fat soluble vitamin A. They have been able, in their feeding experiments, to form calculi in rats and mice by withholding that element from the diet. The exact manner in which these stones form is not understood, but it appears certain that infection plays no part in the process. We have no data that suggest that avitaminosis has been a factor in the cases we have observed.

GEOGRAPHICAL DISTRIBUTION

It is well known that the inhabitants of certain countries and localities are more susceptible to stone than people who live in other parts of the world. Comparatively small areas are known to be rich in stones, while the adjacent territory contains few. In India, for example, urinary calculi are most prevalent in the northern provinces and are rarely seen in southern India. In southern China, stone is exceedingly common, but is very rare in the northern part of that country. It is practically unknown in South America, and is rarely seen in Africa, except in Egypt, and only in the southern part of that country, where it is prevalent. In Great Britain, urinary calculi are rarely seen in the southwestern countries, but they are common along the whole of the east coast. A small part of Derbyshire produces many stones. Civiale stated that stone was more common in Holland than in any other part of Europe. They are rarely seen in Ireland. They are common in the east and southeast of France, yet are practically unknown in Normandy. In the United States the Ohio valley has long been known to be rich in stone. Southern California and southern Florida show a high prevalence.

It is obvious from the above that stone is commonly found in countries and localities that differ widely in climate, soil, and geological formations. At first sight it would appear that climate has no influence on the frequency of lithiasis. Stone is reported to be common in Iceland and Holland, in both of which the climate is cold and moist. Dry heat and marked evening fall in temperature are found in the valleys of the Euphrates and Ganges, where stone is common, but these conditions are also present in the Sudan, where stone is very rare. We believe, with Swift Joly, that dry heat may be a deciding factor in those who are predisposed to stone, as some of the more insoluble salts may be precipitated when the urine is concentrated through loss of water from sweating and surface evaporation; but that it has no effect on those in whom the urinary colloids are able to retain them in solution.

WATER

Our patients who live on the desert attribute their stones to drinking "hard" water. In our investigation we have studied water analyses from various sections and can find nothing to substantiate this view. We believe that the quantity of fluid consumed is more important than the quality, and that only in those individuals in whom the tendency to form stones is active, is the concentration of the urine of importance as a contributory factor. The excessive loss of fluid through surface evaporation that occurs in the inhabitants of arid districts is probably of more importance.

RACE

That some races have a much higher natural protection against stone than others seems well established. In the United States the rarity of calculi among negroes has often been noted. For years, not a negro entered Johns Hopkins Hospital with stone, in spite of the fact that a large percentage of their clinical material was drawn from that race. The Jackson Memorial Hospital of Miami, which is the only institution we know of with a higher stone ratio than our own, and with a large negro population to draw on, admitted but one negro with stone in five years, and he was a distinct mulatto. Holmes and Coplan were able to learn of only three cases among Florida negroes. We have never seen a negro with a calculus.

Whether or not stone is common in Mexico, we are not prepared to state, for as yet we have no data that is reliable. We do know, however, that it is noticeably rare among the Mexican employees of the Santa Fe Railroad. A recent report shows 24 per cent of the Coast Line employees to be of that race, which is slightly lower than normal. Two of the 197 cases (1 per cent) of stone we have seen in that company's hospital were Mexicans, and one of these was born in San Francisco and had never been out of the United States.

OCCUPATION

There is a belief among railway employees that riding on an engine predisposes to kidney trouble. Engineers head the list with twenty-two cases. They all believed that the vibration of the locomotive was responsible for the stones from which they suffered. It is well known that highly saturated solutions will often throw down salts when subjected to oscillation, but we doubt the application here. A strikingly large percentage of railroad engineers are stout and lead sedentary lives, and the majority have been long in the service and are past middle life, when urinary stasis and infection are more prevalent. Firemen, who are subjected to the same vibrations, contributed but one case in our series.

TREATMENT

We have borne in mind the fact that these patients were nearly all dependent on their positions for a livelihood, and that wherever possible they were to be returned to duty with the least delay and as nearly intact as consistent with good practice. The removal of a kidney in a railroad employee may seriously impair his efficiency, and subject him to an increased risk in a hazardous occupation, where trauma to the remaining kidney may cost him his life. Conservative surgery has, therefore, been practiced wherever possible. Nephrectomy was done in but eight instances, in sixty-five cases of renal lithiasis, and these were all for calculous pyonephrosis, where great destruction had occurred. Twenty-five cases of silent stones have not been molested. The majority of these were small and uninfected. They are kept under close observation, wherever possible. In thirty-two patients, renal stones have been removed by operations that did not include removal of the kidney.

RECURRENCES

The incident of recurrences has been low. Five patients (2.5 per cent) in this series have returned with new stones. Three of these were renal, one a vesical calculus, and one ureteral. Two of the renal cases had previously had a pyelolithotomy, the third had had a ureterotomy for stone. The bladder stone formed in a patient who had a litholapaxy, where a fragment was probably left in the bladder. The patient with a stone in the ureter had previously passed a stone from the same side, following dilatation.

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DISCUSSION

F. S. Dillingham, M. D. (1016 South Broadway, Los Angeles).—I believe that more routine x-ray examinations of the genito-urinary tract should be made. There are cases of silent calculi, as mentioned by Doctor Wright, in the kidney, ureter, bladder, and prostate. Many older patients were given morphia for acute renal colic, and because the pain stopped, the stone was thought to have passed and no follow-up examination made. One patient was relieved by a hypodermic of morphin twelve, and again eleven years before examination; and a stone, dice-shaped, and over one centimeter in size, was caught at the pelvic brim, where it formed a diverticulum and caused no symptoms for the next ten years.

After litholapaxy, even when followed by the use of the cystoscope, it has been my habit to use the evacuator two weeks later, as some of the dust or finer particles of sand may become enmeshed on the surface of the bladder wall, and each may serve as the nucleus for a new stone. After an interval of about two weeks, they evacuate easily.

In this age of "alkalies" and "acidosis" my fight has been to make and keep the urine acid. Ammonium chlorid and sodium acid phosphate have given me the best results, but each patient's response must be watched and the measures varied.

Some years ago I noticed that, after a renal pelvic lavage or cystoscopic manipulation for the removal of calculi, the patients were apt to have less discomfort, or colic, if they were ambulatory, than if they went to bed and kept too quiet. Later, in treating cases of multiple, bilateral renal calculi in children recovering from poliomyelitis, it was found that they improved more rapidly if, in addition to mechanical dilatation of the ureters, urinary antiseptics, vitamin A, more fluids, etc., they were encouraged to take more physical exercise. Some who could not stand the pool work at first, would be able to stay in for increasing periods after their ureteral strictures had been dilated above No. 11 F, and were encouraged by the showers of sand and calculi that followed each cystoscopic manipulation. They would observe that more stones would be passed after their pool work, or after a sudden jolt while riding in an automobile.

The truth is forced on those who later have had to handle solitary kidneys with calculi, or a ureter blocked by a stone, that a more minute preoperative study might have saved the other kidney. Nephrostomy may bring back a seemingly hopeless kidney so that more radical work can be done later.

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Dozier H. Gibbs, M. D. (1061 Roosevelt Building, Los Angeles).—It would seem, at the present time, that the problem is confined to the control of the colloid-crystaloid mechanism, which may be influenced by diet, focal infection (specific streptococcic infection as demonstrated by Rosenow), or more probable by some faulty process during the metabolism of certain foods.

In individuals with this abnormal colloid-crystaloid balance, the formation of calculi are hastened by urinary obstruction, infection, highly concentrated urines, etc.; whereas persons with a normal balance do not form stones under the same conditions.

At the Children's Hospital there were only four cases of urinary calculi observed during the past ten years. One of these was a ureteral stone in an Indian boy four months old. I have seen one young negro man with a ureteral stone.

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Miley B. Wesson, M. D. (490 Post Street, San Francisco).—All surgeons know how to treat stones in the kidney. They remove the stones by cystoscopic manipulations, or open operations, and sometimes even do nephrectomies, intentionally or otherwise. What the urologist, as well as the general practitioner, wants to know is how to prevent the formation of stones, or the recurrence of such in kidneys from which stones have been removed.

This subject, the essayist will consider under five headings. First: Prevent urinary stasis by providing adequate drainage. The kidney will clear of an infection without cystoscopic lavages provided there is free drainage. There is a difference of opinion as to whether the stones originate in blocked tubules and fall into the pelvis, or whether they are formed in the pocket above a ureteral stricture and migrate up into the pelvis. If adequate drainage is present, we will probably not have to consider either of these theories, for there will be no stones. Second: Remedy metabolic errors. There will be no exanthin, cystin or urate stones formed without there is a deficiency of vitamin A, and this will not occur if cod-liver oil and such preparations are freely used. Third: Remove specific infections. If there are no urea-splitting organisms present, no phosphate or carbonate stones will be formed. The carbonates are the commonest stones found in the United States, whereas the phosphates predominate in England. Fourth: Eliminate focal infections. Rosenow and Meissler found that by taking a streptococcus from a stone carrier, and injecting the culture about devitalized teeth, renal calculi would uniformly appear. Five: Keep urine acid and sterile by use of mouth antiseptics.

The ordinary preparations routinely recommended for mouth medication are valueless. In several recent researches the investigators uniformly agreed that the Azo dye preparations colored the urine. Hexamethylamin has been our stand-by for years. We knew that it was valueless unless the urine was acid and we depended upon acid sodium phosphate to bring this about. Scientists have now demonstrated conclusively that unless the urine was very highly alkaline to start with, the acid sodium phosphate never caused it to become acid. I might say in passing that acid sodium phosphate, even if it does acidify the urine, can be uniformly depended upon to upset the stomach and cause diarrhea. Litmus paper is valueless in determining acidity of urine. Methyl red must be used. It is yellow at pH 6 and bright red at pH 4.6. Colon bacilli will not live when the hydrogen ion concentration pH remains below 5.5. Ammonium chlorid is very satisfactory for acidifying the urine, but it causes gastric distress and, furthermore, is practically valueless in the 10 or 20 grain doses commonly prescribed. Dilute aqua regia (drams 1 to 8) will bring about a condition of acidity, but most patients do not tolerate well this drug. Ammonium nitrate in enteric-coated capsules will not upset the stomach, and will reduce the hydrogen ion concentration (pH) to below 5.5 in doses of 15 to 30 grains four times per day. Unfortunately these have not been put on the market by any manufacturing chemist. If the patient is hospitalized, the ketogenic diet is very valuable for reducing the hydrogen ion concentration (pH). Doctor Helmholz of the Mayo Clinic has recently shown that to be bactericidal, a concentration of 0.5 per cent betaoxybutyric acid with a pH of 5.2 to 5.3 is necessary. Furthermore, that these patients go into a more satisfactory ketosis if the basal metabolism rate is raised very carefully and conservatively by the administration of thyroid. My experience has been that in only rare cases am I able to produce a sufficient degree of acidity by the ketogenic diet alone, and I supplement it usually with ammonium nitrate pills.

Attempts to dissolve stones have not proved satisfactory in my hands. Phosphate stones are supposed to dissolve with 1 or 2 per cent phosphoric acid when irrigated through a ureteral catheter, or preferably a ureteral catheter and nephrotomy tube. If carbonate stones are irrigated with phosphoric acid, they apparently increase in size and number. Hydrochloric acid, one-half per cent, is supposed to be specific for them, but in my cases such treatment only causes the patient to have chills.

Too often in the field of industrial medicine we meet with nonscientific claims as to the etiology of disease, the compensation angle having a tendency to blur our scientific vision. Locomotive engineers no more get stones from the jolting of an engine cab than does a laborer acquire a "traumatic" epididymitis from lifting a heavy object. They are both secondary to infections, one in the kidney and the other the seminal vesicles. The stones that occur in the kidneys and bladders of patients with broken backs are not due to the injury, but to the infection that uniformly follows catheterization.

DERMO-SUBCUTANEOUS FLAPS—THEIR MANAGEMENT IN RECONSTRUCTION SURGERY*

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Discussion *by Will L. Miles, M. D., Los Angeles; W. S. Kiskadden, M. D., Los Angeles.*

In reconstruction surgery, dermo-subcutaneous flaps are powerful weapons in combating major defects. These flaps, in view of their versatility of application for functional and cosmetic reconstruction, are indispensable for the reconstruction of defects following disease, trauma or operative interference; so that continued study of their construction and application is essential.

There are several general surgical principles that from experience must be considered when constructing flaps, no matter what type. The tissues selected for surgical correction should be identical—or as nearly so as possible to that surrounding the defect—in color, texture, thickness, and contained epithelial elements. It is best to make the base of any flap twice as wide as the tip to insure complete circulation to the distal end; also, in the average case, the tip should be blunt or rounded instead of pointed, thus eliminating the poorly nourished end-piece that may necrose and ruin an otherwise good result. This caution is necessary when dealing with flaps that have a narrow base; or one designed for improvement of function in which the existing scar tissue has to be utilized. The blood supply is important, and when flaps are constructed they should be planned parallel to the arterial supply rather than across it. So, too, Langer's skin lines must be given due consideration; for incisions made to conform with these markings give abundant material with a good blood supply and a minimum of donor scar. This is very forcibly demonstrated in surgery of the hand, for when incisions are made across the grain of the skin or flexion creases disastrous functional results follow. Atraumatic technique of exceptional accuracy should be employed when constructing flaps as well as in all other phases of reconstruction surgery.

TYPES

The four major types of dermo-subcutaneous flaps that we shall consider in this presentation are:

1. Transposed flaps.
2. Rotating flaps.
3. Pedicle flaps.
4. Tubed pedicle flaps.

1. Transposed flaps are the simplest of the group. However, considerable surgical ingenuity is required so to place incisions as to utilize tissue redundancy to its full functional and cosmetic capacity. The object of these flap procedures is tissue conservation of material present, which is

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